Claims

1. (currently amended) A substrate-holding device for holding a substrate while a fabrication process is being performed on the substrate, the substrate-holding device comprising:

a wafer-chuck body defining an adhesion surface and comprising an electrostatic electrode, the adhesion surface being configured to contact a downstream-facing surface of a substrate being held by the substrate-holding device by an electrostatic force generated by the electrode;

the adhesion surface defining a channel configured, whenever the substrate is adhered to the adhesion surface by the electrostatic force, to provide a conduit for a heat-transfer gas such that, ~~when~~as the heat-transfer gas flows in the channel, the gas contacts and removes heat from the downstream-facing surface of the substrate;

a gas-supply conduit configured to controllably conduct the heat-transfer gas from a source to the channel;

a gas-evacuation conduit configured to controllably conduct the heat-transfer gas from the channel; and

a controller configured to (i) cause the heat-transfer gas to flow through the channel from the gas-supply conduit during a predetermined time period when the sensitive substrate is being held on the adhesion surface, (ii) at a first predetermined time instant during the period, commence execution of the fabrication process on the substrate being held on the adhesion surface, and (iii) at a second predetermined time instant ~~relative to~~during execution of the fabrication process, commence evacuating the heat-transfer gas from the channel.

2. (original) The substrate-holding device of claim 1, wherein the controller is further configured to determine, in advance of executing the fabrication process, an expected length of an evacuation time period required to evacuate the heat-transfer gas from the channel, and to set the second predetermined time instant based on the determined expected length of the evacuation time period.

3. (original) The substrate-holding device of claim 2, wherein the controller is further configured to determine the second predetermined time instant as occurring before commencing an exchange, on the adhesion surface, of a new substrate for an already processed substrate.

4. (original) The substrate-holding device of claim 1, wherein the controller is further configured to establish the second predetermined time instant as occurring at an instant when the fabrication process executed on the substrate on the adhesion surface is at least 80% complete.

5. (original) The substrate-holding device of claim 1, wherein:

the heat-transfer gas is helium; and

the controller is further configured to establish a target pressure of the heat-transfer gas in the channel of no greater than 2.7 kPa (20 Torr).

6. (original) The substrate-holding device of claim 1, wherein the fabrication process is an exposure process.

7. (withdrawn)

8. (withdrawn)

9. (withdrawn)

10. (withdrawn)

11. (withdrawn)

12. (withdrawn)

13. (withdrawn)

14. (withdrawn)

15. (currently amended) A wafer chuck for holding a sensitive substrate as a process is being performed on the substrate, the wafer chuck comprising:

an adhesion surface configured to contact a downstream-facing surface of the substrate whenever the substrate is mounted to the wafer chuck, the adhesion surface defining a channel that is enclosed whenever a sensitive substrate is mounted to the wafer chuck;

an electrode situated and configured to attract the sensitive substrate by electrostatic attraction such that the substrate is held on the wafer chuck with the downstream-facing surface contacting the adhesion surface, thereby enclosing the channel;

a heat-transfer-gas (HTG)-inlet port situated and configured to introduce a heat-transfer gas into the channel to contact with the downstream-facing surface of the substrate mounted to the adhesion surface;

a gas-evacuation port situated and configured to allow evacuation of heat-transfer gas from the channel; ~~and~~

a valve mounted to the wafer chuck, the valve being configured to open and close at least one of the inlet port and the evacuation port; and

a controller connected to the valve and configured to open and close the valve as required to cause heat-transfer gas to flow through the channel and to stop flow of heat-transfer gas through the channel, respectively, during a predetermined time period in which the substrate is being held on the adhesion surface, and, at a predetermined time instant during performance of the process on the substrate, commence evacuation of the heat-transfer gas from the channel in anticipation of removing the substrate from the wafer chuck after completion of the process.

16. (original) The wafer chuck of claim 15, wherein the process is an exposure process.

17. (canceled) The wafer chuck of claim 15, further comprising a controller connected to the valve and configured to open and close the valve as required to controllably cause heat-transfer gas to flow through the channel and to stop flow of heat-transfer gas through the channel.

18. (withdrawn)

19. (withdrawn)

20. (withdrawn)

21. (withdrawn)

22. (withdrawn)

23. (withdrawn)

24. (withdrawn)

25. (withdrawn)

26. (withdrawn)

27. (withdrawn)

28. (withdrawn)

29. (withdrawn)

30. (withdrawn)

31. (withdrawn)

32. (withdrawn)

33. (withdrawn)

34. (withdrawn)

35. (withdrawn)

36. (withdrawn)

37. (withdrawn)

38. (original) A substrate-holding device, comprising:

a wafer chuck comprising an adhesion surface and a heat-transfer-gas (HTG) channel;

an HTG-supply system connected to the channel and configured to supply a heat-transfer gas to the channel; and

a cold trap connected to the HTG-supply system such that heat-transfer gas intended to enter the channel passes through the cold trap before entering the channel, the cold trap being configured to remove impurities from the heat-transfer gas as the gas passes through the cold trap.

39. (original) The substrate-holding device of claim 38, wherein the cold trap further comprises:

an adsorbent for collecting the impurities;

a vessel configured to contain a cooling substance at a temperature sufficient to at least liquefy impurities in the heat-transfer gas so that the impurities can be adsorb onto the adsorbent; and

an exhaust system connected to the cold trap, the exhaust system comprising an exhaust duct, an exhaust valve, and an exhaust pump, the exhaust valve and exhaust pump being controllably operable to isolate the cold trap from the channel and remove the adsorbed impurities from the adsorbent, respectively.

40. (original) The substrate-holding device of claim 39, further comprising a recirculation conduit configured to recover heat-transfer gas passing through the channel and to direct the recovered heat-transfer gas to a location upstream of the cold trap so as to pass through the cold trap to the channel.

41. (original) The substrate-holding device of claim 40, further comprising:

a bypass valve connected to the recirculation conduit;

an HTG-inlet valve connected to the HTG-supply system; and

a controller connected to the bypass valve, the HTG-inlet valve, the exhaust valve, and the exhaust pump, the controller being configured to operate the HTG-inlet valve relative to the exhaust pump so as to supply heat-transfer gas to the HTG channel, to operate the exhaust valve and exhaust pump relative to the HTG-inlet valve to remove heat-transfer gas from the HTG channel, and to operate the bypass valve to recirculate the heat-transfer gas.

42. (original) A substrate-processing apparatus, comprising the substrate-holding device of claim 38.

43. (withdrawn)

44. (withdrawn)

45. (withdrawn)

46. (withdrawn)